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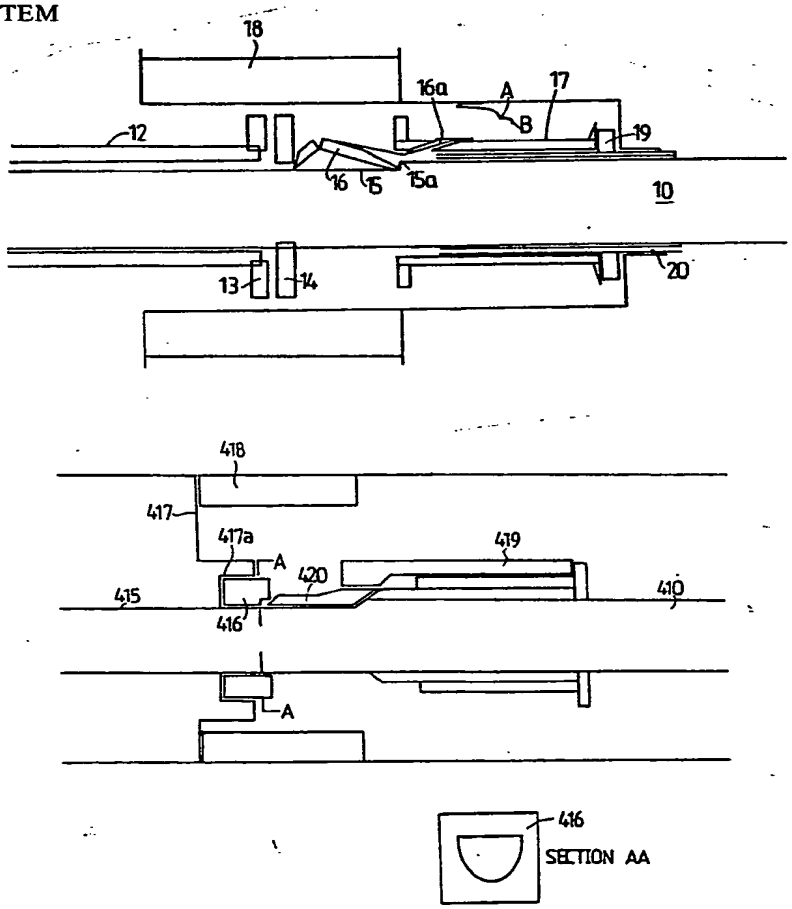
(54) Title: VEHICLE STEERING SECURITY SYSTEM

(57) Abstract

A locking and unlocking clutch arrangement for a vehicle security system wherein clutch members (13 and 14) are maintained in engagement by the combined action of a permanently magnetized tubular sleeve member (17) and a locking key (16), a solenoid winding (18) magnetically controls movement of the sleeve member (17) between a locking position and a free wheel position where the sleeve member (17) is forced to move along shaft (10) to contact a magnetic stop (19), a remotely located switch is used to activate the solenoid winding (18). Also disclosed is a steering shaft lock wherein a solenoid (418) is energized to move a cam member (419) thereby forcing detent (420) into an aligned position along shaft (410) forcing key member (416) into locking engagement with recess (417a).



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VEHICLE STEERING SECURITY SYSTEM

FIELD OF THE INVENTION

This invention relates to a remote actuated locking clutch system and in particular a steering security system useful for the prevention of unauthorised use of a motor vehicle by rendering the steering mechanism inoperative.

BACKGROUND TO INVENTION

Conventional systems known to applicant embody locking devices associated with the ignition key cylinder and including a bolt capable of locking the steering shaft against movement. Such a type is disclosed in Australian specification Nos. 513,206 and 517,092.

It has been found with conventional steering in use, that is those mechanisms which lock the steering against movement when the vehicle is not in use, that the housing and/or mechanism lack sufficient strength to withstand leverage on the steering wheel by a suitable lever member such as a jemmy bar. Thus the steering lock mechanism is easily made inoperative whereby normal steering of the vehicle is possible. The existence of the steering lock does not render the vehicle steering mechanism inoperative, it simply denies access thereto. However, being relatively easily broken it provides security which in many instances is inadequate.

This problem has been addressed in U.S. specification Nos. 3,566,633 and 3,566,634 assigned to Borg-Warner Corporation wherein in the first mentioned specification a steering column lock incorporates a "break-away torque" to prevent or minimise the breakage of components in the steering lock.

The second mentioned specification provides that the steering wheel and upper portion of the steering column will free wheel with respect to the lower portion of the column and steering linkage. This specification addresses the problem of component damage and easy forcing of the

conventional locking mechanism by utilising mechanical components capable of effecting disengagement of the steering wheel from the steering linkage and therefore preventing effective steering of the vehicle.

Applicant is not aware of any public or private use whatsoever of the apparatus disclosed in the above mentioned U.S. specifications. Applicant is also aware of Australian patent specification No. 34790/84 based upon a Spanish patent application. This specification was published in Australia after the earliest filing date of my application, however the disclosure therein relates to mechanical componentry to provide for disengagement of the steering column link between the steering wheel and the steering linkage. In each instance the disengagement and engagement is performed mechanically and requires the proximity of the ignition switch to the lock to allow direct mechanical interaction between the ignition switch and the steering column lock.

Whilst the prevention of damage to componentry by unauthorised use is an important feature the present invention sets out to overcome a further problem, namely the conventional but relatively inaccessible location of the ignition switch on the steering column and the relatively complex construction of the prior art devices which leads to greater expense in manufacture.

It is a principal objective of the present invention to provide a locking clutch for a drive shaft system wherein the clutch may be actuated at a remote location.

It is a further objective of the present invention to provide a vehicle steering security system which will overcome the problems inherent in existing systems known to applicant, namely component breakage, complexity of construction and control.

It is a further objective of the invention to render a motor vehicle un-steerable by provision of a free

wheel device to which access is difficult and which can be remotely actuated. Thus, a device rendering the vehicle steering mechanism inoperative is provided which is difficult to tamper with in an unauthorised manner and is more effective than a conventional steering column locking system.

There is provided according to the present invention in a locking and unlocking clutch system for a shaft including a first and second clutch member connectable to a shaft, at least one of the clutch members being movable relative to said shaft to cause locking and unlocking of said shaft, the improvement comprising electromotive actuation means, one of said clutch members being responsive to said actuation means to cause said movement, remote control means, such as an electric switch, for operating said actuation means to cause said locking and unlocking of said clutch at a remote location.

There is provided according to a specific aspect of the present invention a steering mechanism security device for a motor vehicle comprising a steering column connectable to a steering box of a motor vehicle, said steering column including interlock means associated with said steering column wherein said interlock means is separable to break said connection to said steering box to render the steering inoperative.

This is also provided in a steering mechanism for a motor vehicle including a steering linkage and a steering shaft operated by a steering wheel for steering the motor vehicle and a security lock system preventing unauthorised operation of said motor vehicle, the improvement including electromotive operable interlock means on the shaft responsive to electrical current supplied thereto, said current flow being controlled by an electrical switch located remote from said interlock means, the arrangement being such that the interlock means in one position prevents operation of the steering linkage and in another position allows operation of the steering linkage.

Conveniently, the interlock means is a mechanical coupling operated by mechanical, pneumatic, hydraulic, or electric means.

The mechanical coupling may comprise a split shaft with an associated slidable sleeve movable from a shaft locking and unlocking position preferably by electro-magnetic means.

Various constructions are envisaged falling within the broad inventive concepts of providing a free wheeling steering column shaft to prevent normal operation of the steering mechanism of a motor vehicle; or to provide a locking and unlocking clutch system controlled electrically from a remote location. The invention will be described in greater detail having reference to the accompanying drawings in which:-

Figures 1 and 3 are cross-sectional views of one practical arrangement of a clutch system as applied to a steering assembly for a motor vehicle.

Figure 2 is a part sectional view of a further practical arrangement.

Figures 4 and 5 show typical electrical control circuits suitable for controlling the clutch system.

Figures 6 and 7 show an alternative practical arrangement of a clutch system.

Figures 8 and 9 show alternative clutch systems for locking the shaft against motion.

With reference to Figures 1 and 3 part of a steering shaft 10 has mounted at one end a steering wheel 11 connected to a splined tube 12 having torsional strength at least equivalent to the steering shaft 10. The tube 12 includes at one end a clutch member 13 of non-magnetic material which is adapted to frictionally and mechanically engage in the manner of a clutch with a magnetic clutch member 14. For example the contacting surfaces of the members 13 and 14 may include mating ribs and slots to ensure positive interlock of the members in operation.

The shaft 10 includes a key way 15 housing a

locking key 16 of non magnetic material and having a hinged construction for a purpose that will be described in more detail later.

The clutch members 13 and 14 are maintained in engagement by the combined action of a permanently magnetized tubular sleeve member 17 and the locking key 16.

A solenoid winding 18 connected to a current source surrounds the clutch members at a central point and is adapted to magnetically control movement of the permanently magnetized tubular sleeve member 17 between an operative locking position as shown in Figure 1 and an inoperative free wheel position as shown in Figure 3 where the sleeve member 17 is forced to move along shaft 10 to contact the magnectic stop of magnetic material 19. The magnetic sleeve 17 will be held in that position pending energisation of the winding 18 to pull the sleeve back to the operative position shown in Figure 1.

The shaft includes a liner 20 of non-magnetic material to facilitate sliding movement of the sleeve 17 between the two positions. Thus, in one direction of current flow the magnetized sleeve 17 is repelled towards the stop 19 and in the other direction of current flow is attracted towards and into engagement with the clutch members 13,14.

Once the magnetized sleeve is moved into engagement with the clutch member 14 the locking key 16 is flattened and fills the keyway space 15 between the step 15a and the bottom edge of the clutch member 14.

Thus the clutch member 14 is maintained in close mechanical engagement with the clutch member 13 and the key 16 is maintained locked in the key way 15 by the sleeve 17 enveloping the key 16.

In the unlikely event that the magnetized sleeve should break loose from the clutch member 14 it will contact electrical contact A which is wired to electrically activate winding 18 to re-attract the sleeve back.

Thus the clutch members are locked together when the device is in its passive state, namely, without any current flow in winding 18. Similar comments apply with the sleeve 17 positioned in the inoperative position attached to the stop 19 until such time that the winding is suitably energised to attract the sleeve 17 back to its operative position.

Movement of the sleeve 17 towards the stop 19 will activate the loose coupling with the key 16 and key linkage 16a whereby the clutch members 13, 14 will disengage. The key 16 in its locking position has the added function of preventing any relative circumferential movement between the tube 12 and the shaft 10 when locked in its operative position. Various electrical circuit arrangements may be provided to energise the solenoid and one preferred form will be described in greater detail later.

Figure 2 shows a modified split shaft arrangement 100, 101, in which a splined sleeve 102 is provided to lock the two shafts together for normal steering operation and an inoperative position where the shafts are not locked together and the steering wheel is disconnected from the steering box.

The sleeve 102 is in fact a solenoid of an electromagnetic device movable between a locking position as shown and an unlocking position against permanent magnet 103.

Depending upon the direction of flow of current to the solenoid 102 the solenoid will be attracted to the permanent magnet 104 or to permanent magnet abutment 103 having opposite polarity. The solenoid includes splines on its internal surface interengaging with splines on the shafts 100 and 101. This enables the solenoid to either lock the shafts 100 and 101 together or with unlocked position against magnetic abutment 103 allow relative rotary movement of the shafts so that the steering wheel is disconnected from the steering linkage.

The polarity of the small bar magnets 105 is selected so that they repel one another to a key locking position as shown at 106 in the shaft locked position. The bar magnets 105 are repelled inwardly by the solenoid when the solenoid polarity is reversed to allow movement to a shaft unlocked position.

The sleeve 102 is held in its locking position by magnet 104 and is also locked by small bar magnets 105.

The arrangement is such that directional control of the current flow in the solenoid winding 102 will control the positioning of the sleeve in a locking or unlocking position to achieve the stated objectives of the invention.

In an alternative arrangement (not shown) to that shown in Figures 1 and 3, the clutches 13 and 14 may be dispensed with leaving the locking key 16 to interlock directly with the torsion splined tube 12. To ensure adequate strength of the connection one or more locking-keys may be arranged around the shaft circumference in repetitive fashion. In a further alternative, the shaft may be interlocked by a pin or pins (not shown) movable radially into and out of engagement with the shaft so that the shaft and steering wheel are locked for movement of the steering mechanism or allowed to free wheel respectively in accord with the invention.

The locking pin or pins may be actuated by known means such as electro mechanical devices, hydraulic or pneumatic, electrical or mechanical means.

A further embodiment of the invention as illustrated in Figures 6 and 7 will now be described. The principle of operation is not unlike that illustrated in Figures 1 and 3.

The solenoid 218 is preferably double wound to provide reversible polarity at the poles and will be described in greater detail later.

The solenoid 218 is mounted on steering shaft housing 221 in fixed location surrounding steering shaft

210 and sleeve 212. The steering wheel 211 is fixed to sleeve 212 and rotatably mounted by bearing 230 onto shaft 210. The sleeve 212 is mechanically engageable with shaft 210 by clutch members 213,214. Figure 6 shows the clutches disengaged and Figure 7 shows them engaged.

The clutch member 213 is non-magnetic whilst member 214 is of permanent magnetic material. A sleeve 217 also of permanent magnetic material is mounted for slidable movement under the influence of the solenoid winding 218. Figures 6 and 7 show the extremes of movement of the sleeve 217 between stop 223 and 222. The sleeve includes an internal cam surface 217a adapted to engage with detent key 216 during sliding movement of the sleeve under the influence of the solenoid winding.

In the position shown in Figure 7 the cam sleeve 217 forces the detent key to lay along the chordal surface 215 of the shaft 210 thus forcing the clutch member 214 into engagement with clutch member 213. The magnetic clutch member 214 is also forced to contact the member 213 under the influence of the magnetic field generated by solenoid 218. Thus in this position the sleeve 212 and shaft 210 are locked together and motion of steering wheel 211 is transmitted directly to the shaft 210 and then to the steering linkage (not shown) but which may be of conventional construction. Sleeve 219 is stepped to allow full movement of cam sleeve 217 to the position shown in Figure 7.

The locking keys 220 of magnetic material are located to retain the cam sleeve 217 with position shown in Figure 7. The cam sleeve and keys may include inter-engaging grooves and ribs to create a positive lock. Thus when current is not flowing to the solenoid the cam sleeve is still fixed in its position as shown.

To unlock the connection between sleeve 212 and shaft 210 the polarity of the solenoid is reversed by reversing current flow or energising a second coil whereby

locking keys 220 mounted on member 220a are lifted away as shown in phantom outline and cam sleeve 217 is moved to the left towards the clutch members 213, 214 (see Figure 6). This allows radial and axial movement of the detent key 216 which in turn frees clutch member 214 to move to the right. The opposite polarity of the solenoid also influences the magnetic member 214 to so move. Thus the connection between sleeve 212, steering wheel 211 and the shaft 210 is broken and the steering linkage cannot be operated by the steering wheel.The housing 221 provides a tamper-proof casing for the mechanism.

Figure 6 shows a simple control circuit for the solenoid which includes a resistance capacitive current pulse circuit 300 and 301 connected to two windings in the solenoid via terminals 302,303. The circuit is controlled by a switch 304 which may be also an ignition switch for the vehicle. The wiring from the switch to the solenoid is preferably housed in a tamper-proof manner to prevent unauthorised operation once the switch has been removed. The switch 304 includes two way terminals 305, 306 for reversing the current flow to the solenoid coils.

Thus a fail safe tamper-proof mechanism is provided which can be actuated by a simple electrical switch which can be conveniently located for operation by the vehicle driver. It will be appreciated that the switch is not required to perform any mechanical function insofar as the steering column lock is concerned and therefore is not required to be located in a relatively inaccessible position on the steering column housing. Furthermore, in the embodiment described the steering wheel is rendered free wheeling and useless to steer the vehicle with the clutch members 213,214 disengaged and therefore mechanical damage that is often caused with conventional steering locks where locking pawls are broken is avoided.

Thus the major advantage of the present invention is the provision of an electrical actuator switch which may

be located in any desired position most favoured by the manufacturer or driver of the vehicle, this being made possible by the electromotive actuation of the steering shaft locking and unlocking mechanism.

Further embodiments of the present invention are illustrated in Figures 8 and 9. With reference to Figure 8 this illustrates a shaft locking device which renders the steering shaft 410 immovable relative to the housing frame 417. The shaft 410 is connected at each end to a steering wheel and linkage (not shown) of conventional construction.

The shaft includes a flat portion 415 upon which key member 416 rests. The shaft is rotatable relative to housing frame 417 which is fixed and houses the solenoid winding 418 and part of the electrical control circuit not shown but which is similar to that illustrated in Figure 6 for example. The section on line A-A illustrates the cross-section of the aperture in key member 416 which keys onto the shaft portion 415.

The key member 416 is movable responsive to detent 420 and slidable magnetic cam member 419 which is movable axially along the shaft under the influence of the magnetic field generated by solenoid winding 418. The solenoid is energised by a reversible current supply so that the cam member 419 is influenced to selectively move either to the left or right. Movement to the left will release detent member 420 for radial movement which in turn will release key member 416 from locking engagement with the housing recess 417a. Movement of the cam member 419 to the right to the position shown in Figure 8 will force detent 420 into a substantially aligned position along shaft 410 thereby forcing key member 416 into locking engagement with housing recess 417a and thereby locking the shaft against rotation relative to the housing. Thus the key 416 or housing 417 must be broken before the shaft can be turned when locked.

Figure 9 illustrates an alternative embodiment wherein the steering shaft 510 includes at least one key hole 511 aligned with a key 512 said key being under the

influence of a magnetic field selectively generated by solenoid 518. The current in the solenoid is reversible so that the key is influenced to move radially into engagement with the key hole or out of engagement. The housing 517 is fixed and thus said locking engagement of the key 512 will prevent turning of the shaft.

In each embodiment shown in Figures 8 and 9, a simple electrical circuit illustrated in Figures 3, 4 or 6 controlled by switch 304 will be adequate to control operation of the solenoid. In each instance a tamper-proof connector plug 307 is provided positioned in an inaccessible position relative to the ignition key switch 304 whereby if the switch is tampered with or removed the connectors 307 are disconnected and renders the solenoid circuit unworkable such that it is impossible either to unlock the key member 416 and 512 (see Figures 8 and 9) and thus allow movement of the steering shaft or to lock key member 16, or 216, or to close clutch members 13, 14 or 213, 214 to connect the steering wheel to the steering linkage to allow steering of the vehicle.

The control of the solenoid is simply carried out by a remotely located switch which can be positioned at any convenient location for the driver of the vehicle or an operator of the clutch mechanism. The remote location of the switch also means that the electrical circuit can be rendered tamper-proof in a simple manner thus rendering the mechanism useless for normal operation yet being easily repaired by skilled mechanics after dismantling of the surrounding housing. This work is not difficult however it consumes time which thereby would deter a would-be thief or unauthorised user of the mechanism.

Tamper-proof plugs 307 are mounted in an inaccessible location preferably within the steering column housing 221. The leads from the switch 304 to the plugs 307 are conveniently of very short length so that any illegal tampering with the switch, such as by removal from its

mounting, will immediately disconnect plugs 307 and render the steering lock mechanism inoperable. Therefore where mechanism provides the free wheeling facility described herein of the steering wheel the vehicle is rendered undrivable until the componentry is re-assembled in the workshop.

Alternatively where a steering lock mechanism is provided (as illustrated in Figures 8 and 9) the lock must be physically broken if the vehicle is to become steerable. The delay involved in repairing the electrical circuit would deter most thieves from persisting in an attempt to steal the vehicle or break a safe, for example, because any significant delay is a major enemy to would be thieves.

With reference to Figures 4 and 5, these show control circuit diagrams which may be used to control the clutch system of the present invention as an alternative to that shown in Figure 3.

Firstly with reference to Figure 3, the switch 304 is operated by a key or code tag and in position 305 energises solenoid winding 218 through terminals 302a and 303a the position 306 energises solenoid winding 218 through terminals 302b, and 303b to reverse the polarity of the solenoid. When the capacitor resistive circuits 300, 301 are energised the capacitor will apply a pulse to the solenoid a sufficient length of time to ensure the magnetic cam member 217 and key 216 will move to their respective positions.

Preferably the resistance is of sufficient value to allow a small holding current to flow to supplement the permanent magnetic attraction of components in place by continually energising the solenoid. The application of the holding current also allows the capacitor to discharge when the key 304 is turned off thus allowing the capacitor to recharge when activated. Should power be lost to the circuit the permanent magnet attraction of components is sufficient to maintain position of the components and further in the case of a steering column gravity also

provides a force for maintaining a locked position.

When the ignition key is removed from position 306 winding 218 through terminal 302 is energised causing cam member 217 to migrate to the left as shown in Figure 6 and unlock the clutches. The magnetic field generated by the solenoid is sufficient to break the permanent magnetic attraction of the components.

With reference to Figures 4 and 5 when the switch 304 is operated to 'on' a pulse is supplied by capacitor 340 to the base of transistor 341 causing it to turn on. Because of the current gain of the transistor the value of the capacitor can be small. When switch 304 is pulled out the capacitor 342 and associated transistor 343 reverse the procedure to render the steering shaft inoperative.

Transistor 344 provides an optional override. At any time if a voltage is applied to transistor 344 from for example an operator ability test system or security alarm transistor 344 will clamp the base of transistor 341 thus preventing operation of transistor 341 and preventing unlocking of the security system.

Figure 5 operates in a similar manner to that described for Figure 4. In the 'on' position of switch 304 power is supplied to the base of transistor 344 via resistor 345 to saturate the transistor and cause a holding current to flow via the transistor and resistor 346. Thus the holding current prevents magnet migration and power dissipation is low.

The specific arrangements described herein refer to security arrangements to prevent theft of motor vehicles, however the invention has application in any drive shaft application in association with sensing technology where for example, an overload situation may otherwise cause damage to associated machinery.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. In a locking and unlocking clutch system for a shaft including a first and second clutch member connectable to a shaft, at least one of the clutch members being movable relative to said shaft to cause locking and unlocking of said shaft, the improvement comprising electromotive actuation means, one of said clutch members being responsive to said actuation means to cause said movement, remote control means, such as an electric switch, for operating said actuation means to cause said locking and unlocking of said clutch at a remote location.

2. In a steering mechanism for a motor vehicle including a steering linkage and a steering shaft operated by a steering wheel for steering the motor vehicle and a security lock system preventing unauthorised operation of said motor vehicle, the improvement including electromotive operable interlock means on the shaft responsive to electrical current supplied thereto, said current flow being controlled by a switch means located remote from said interlock means, the arrangement being such that the interlock means in one position prevents operation of the steering linkage and in another position allows operation of the steering linkage..

3. A steering mechanism security device for a motor vehicle comprising a steering column connectable to a steering box of a motor vehicle, said steering column including interlock means associated with said steering column wherein said interlock means is separable to break said connection to said steering box to render the steering inoperative.

4. The steering mechanism as claimed in claim 2 wherein the electrical connection between said electromotive operable interlock means and said switch

means include means which are substantially tamper-proof operable to open said electrical connection when the switch means is illegally removed.

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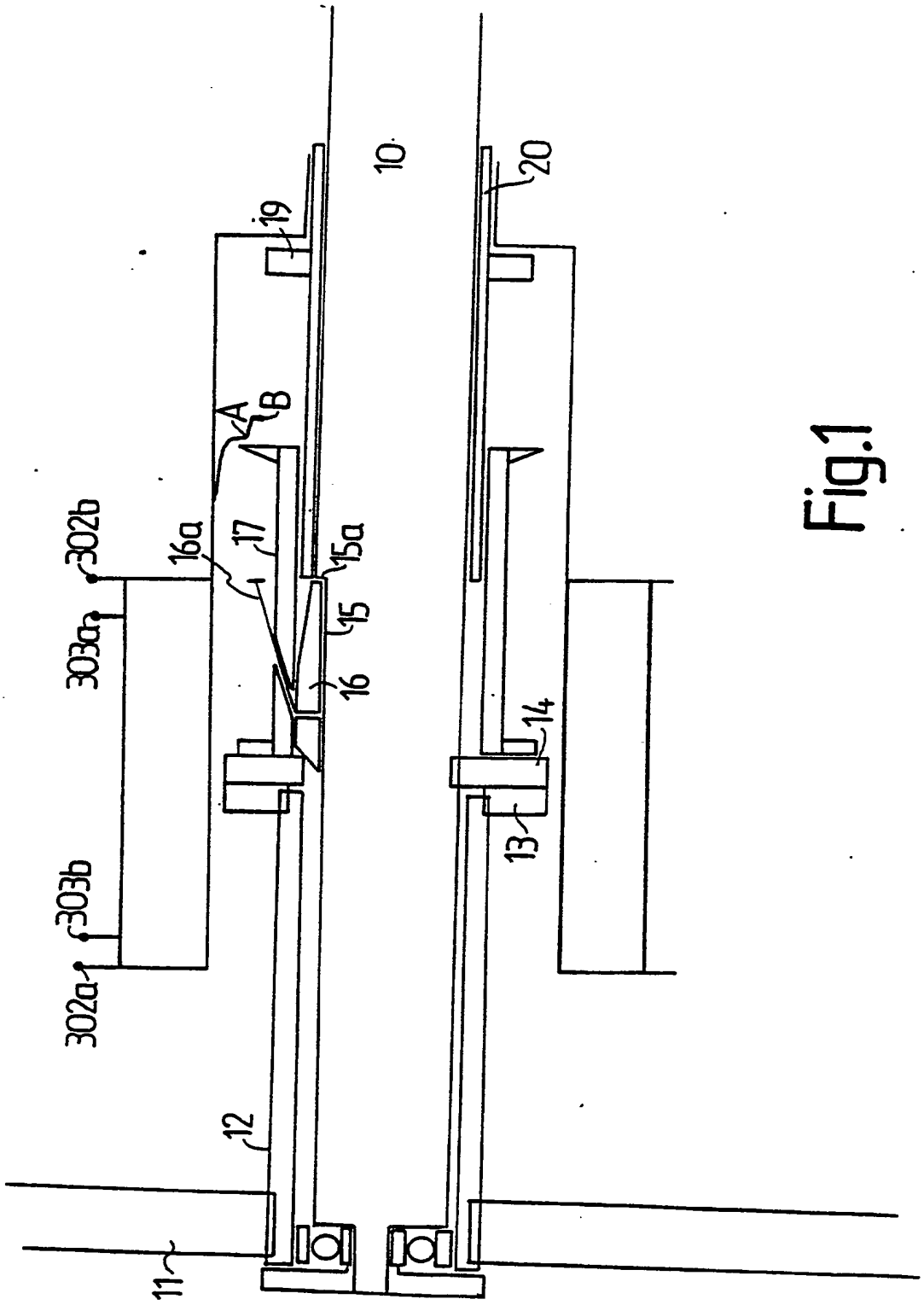
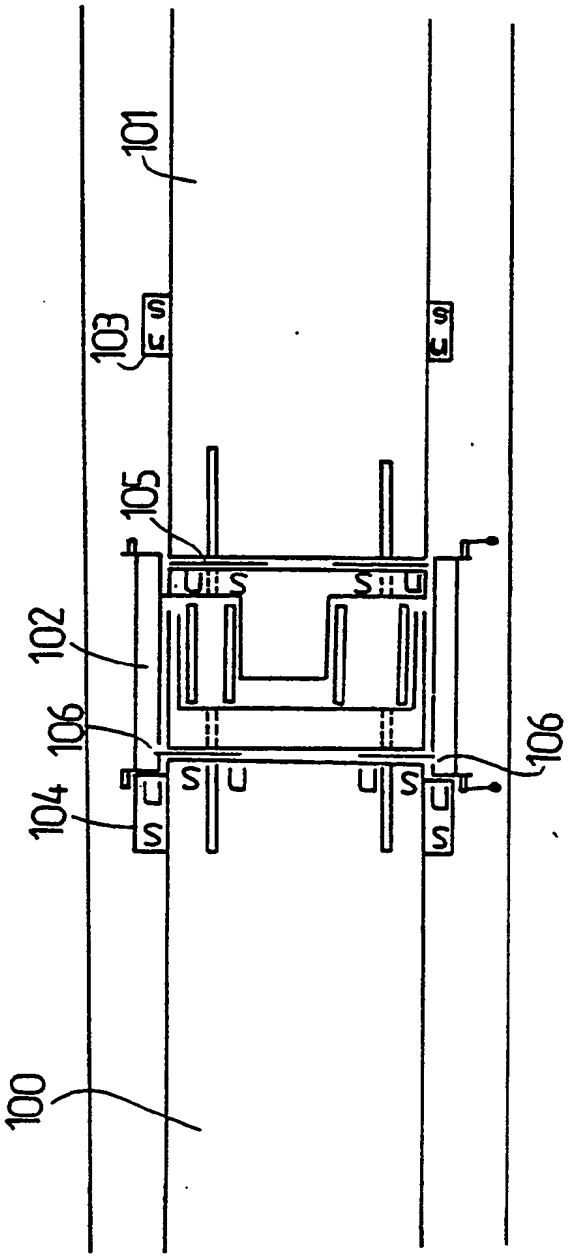


Fig.1

Fig.2



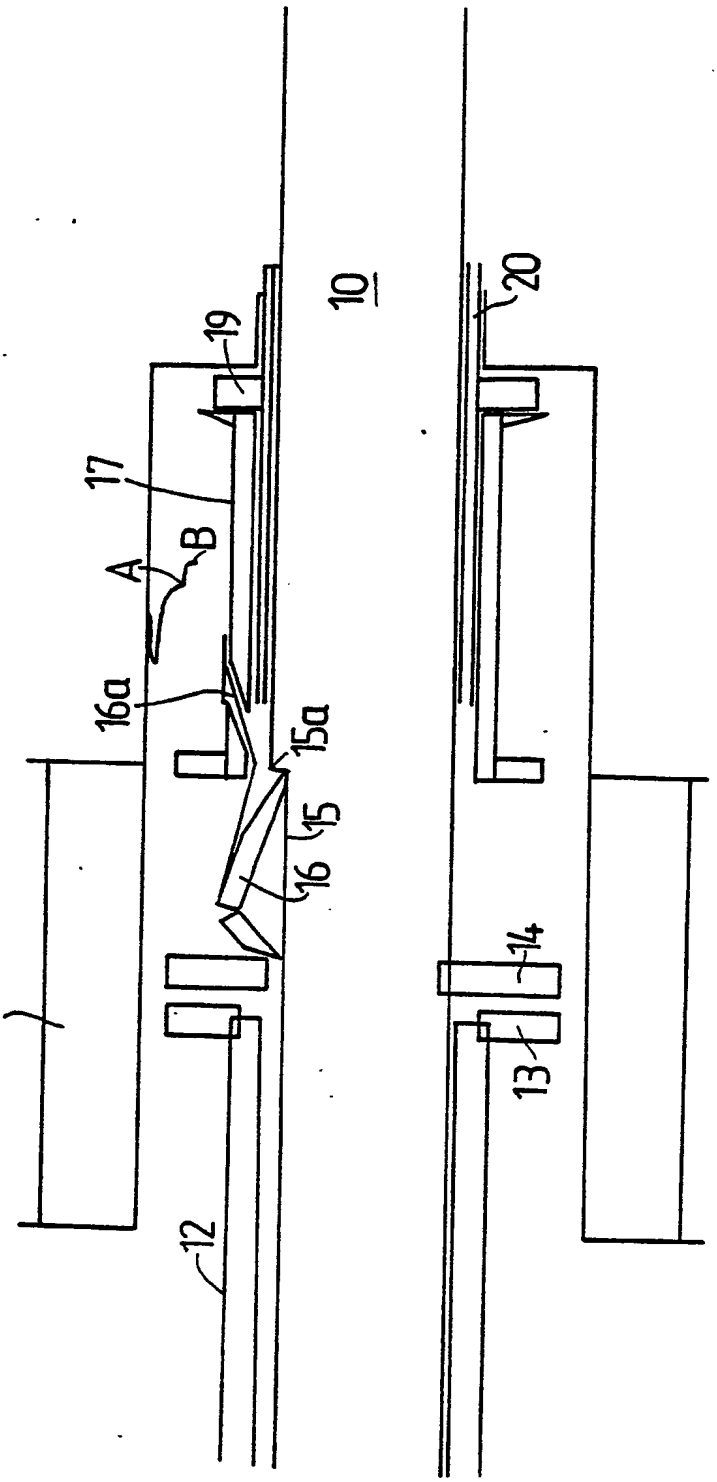


Fig.3

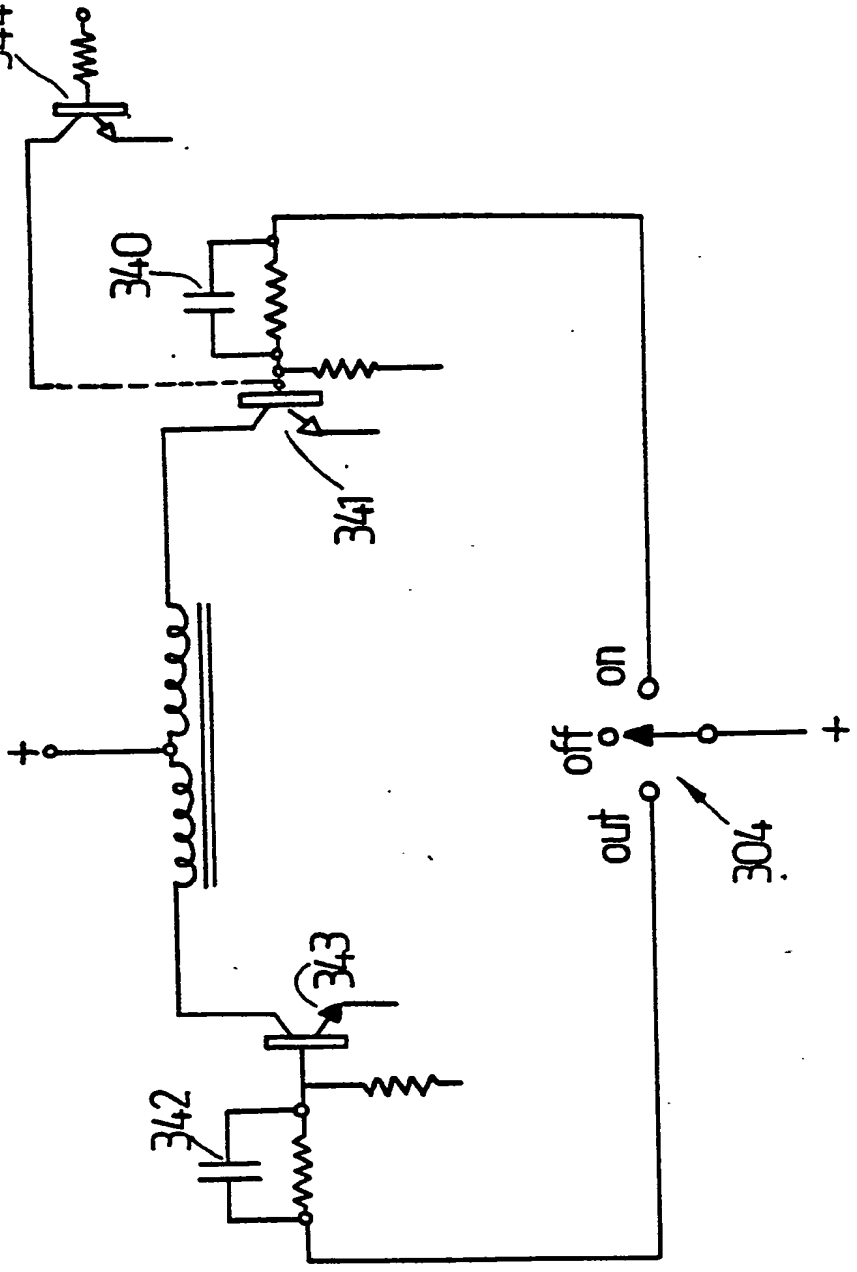


Fig.4

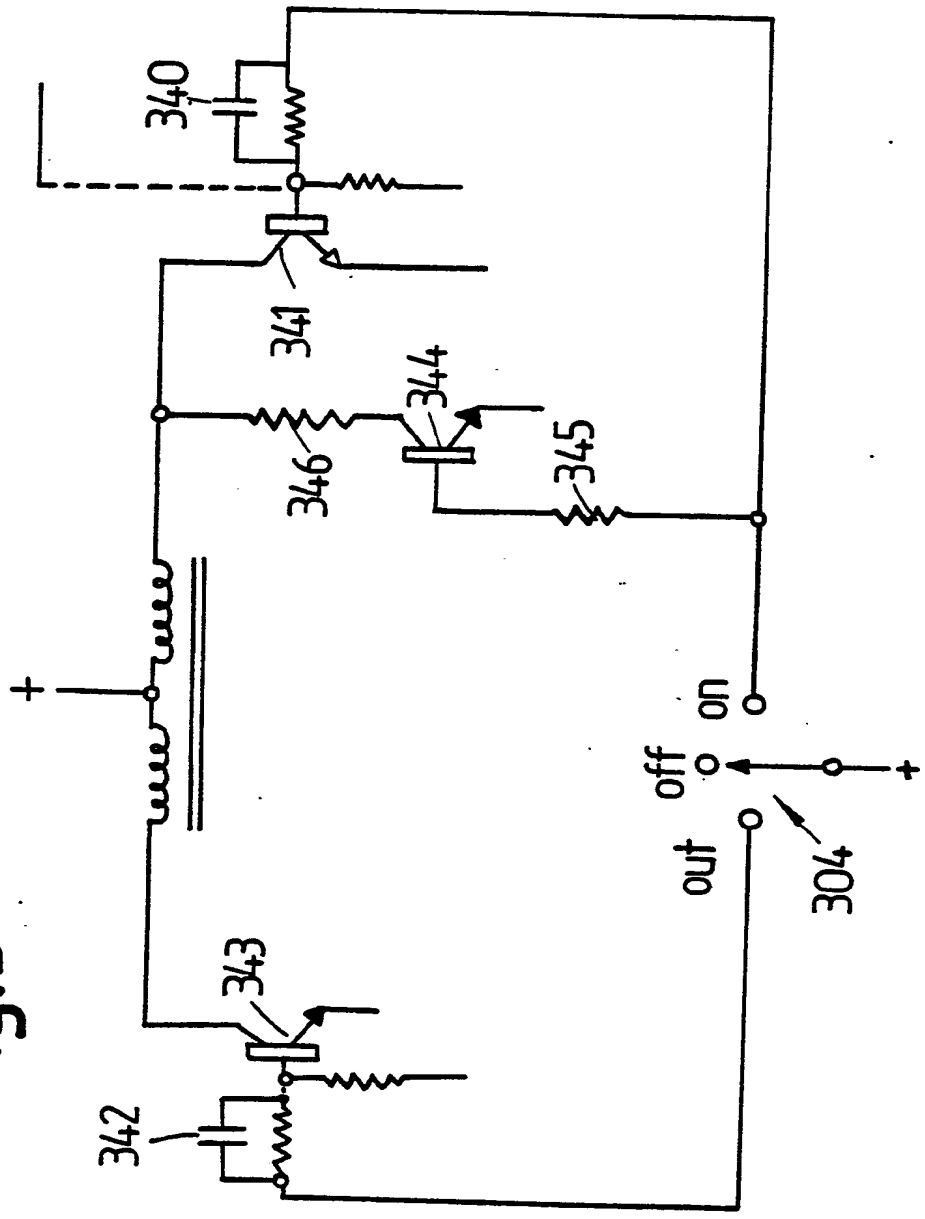
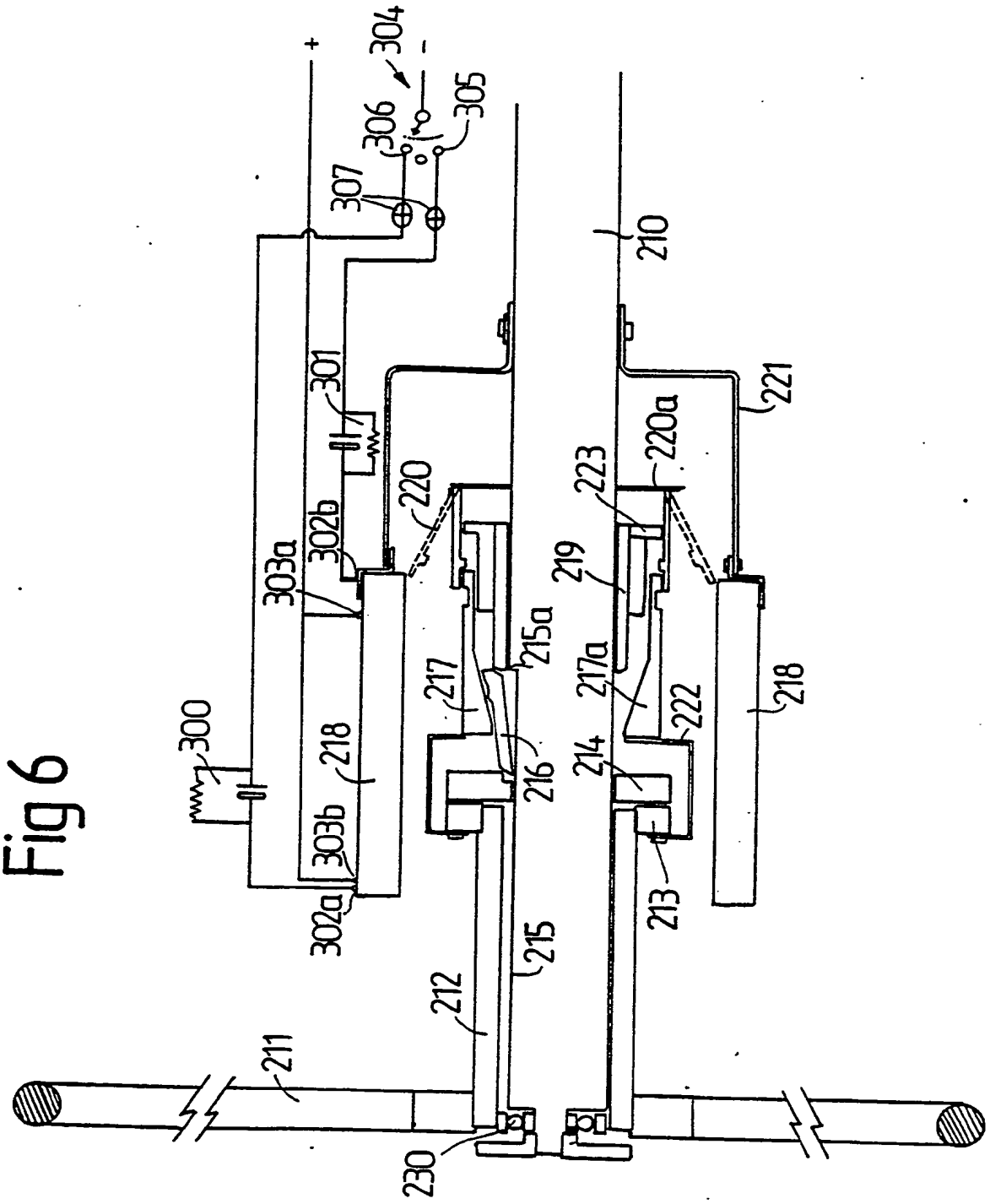


Fig.5

Fig 6



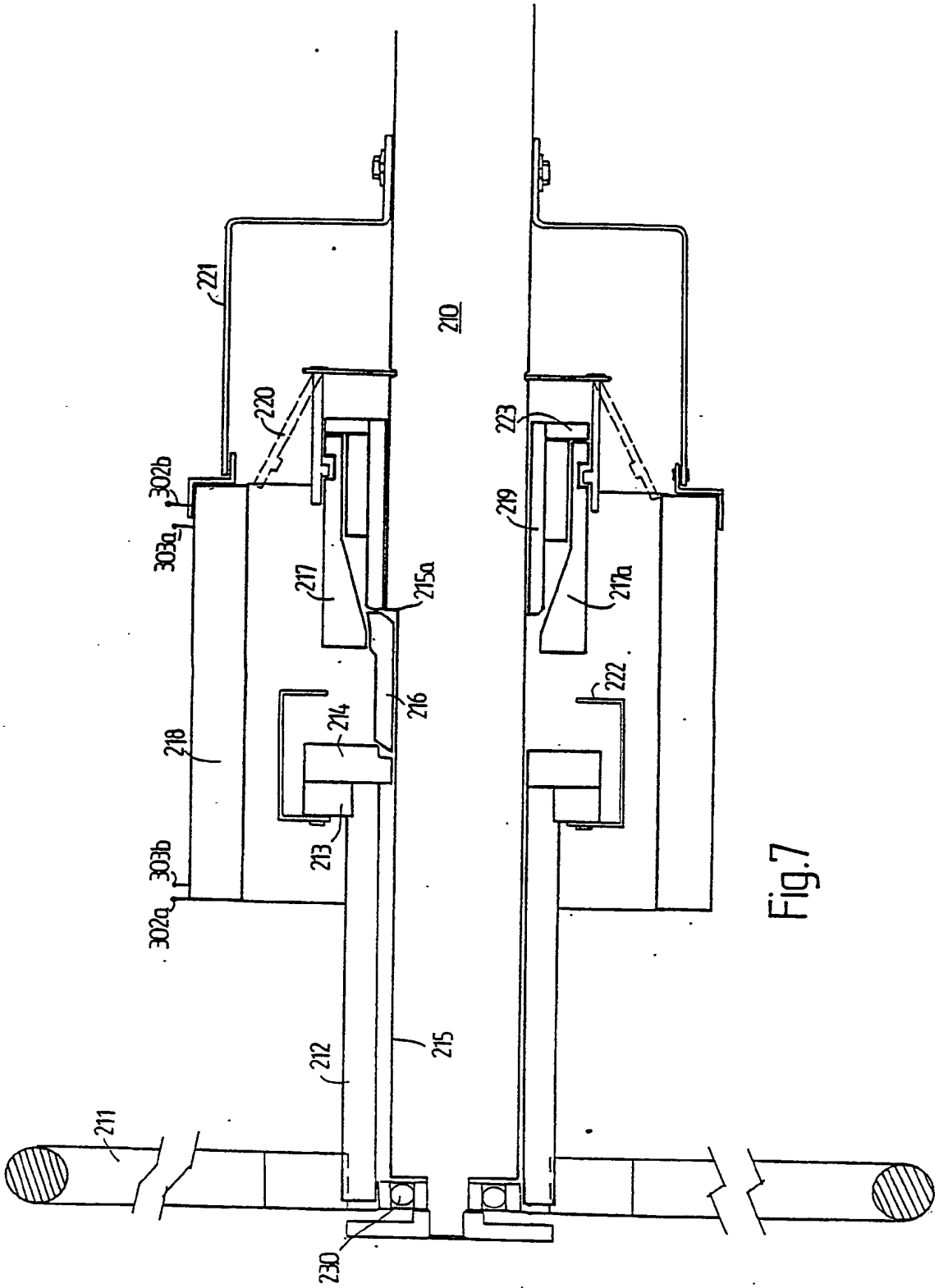


Fig.7

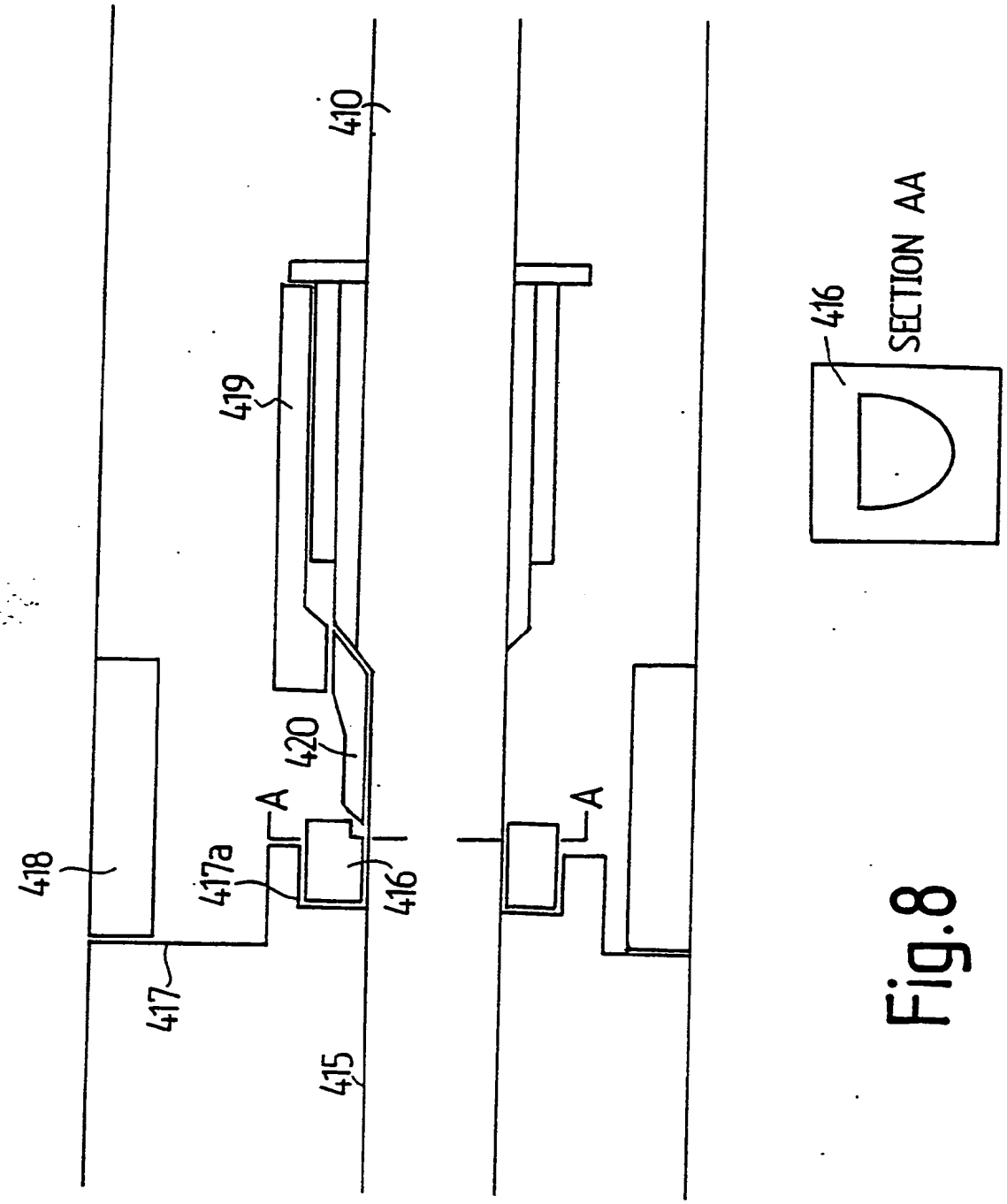
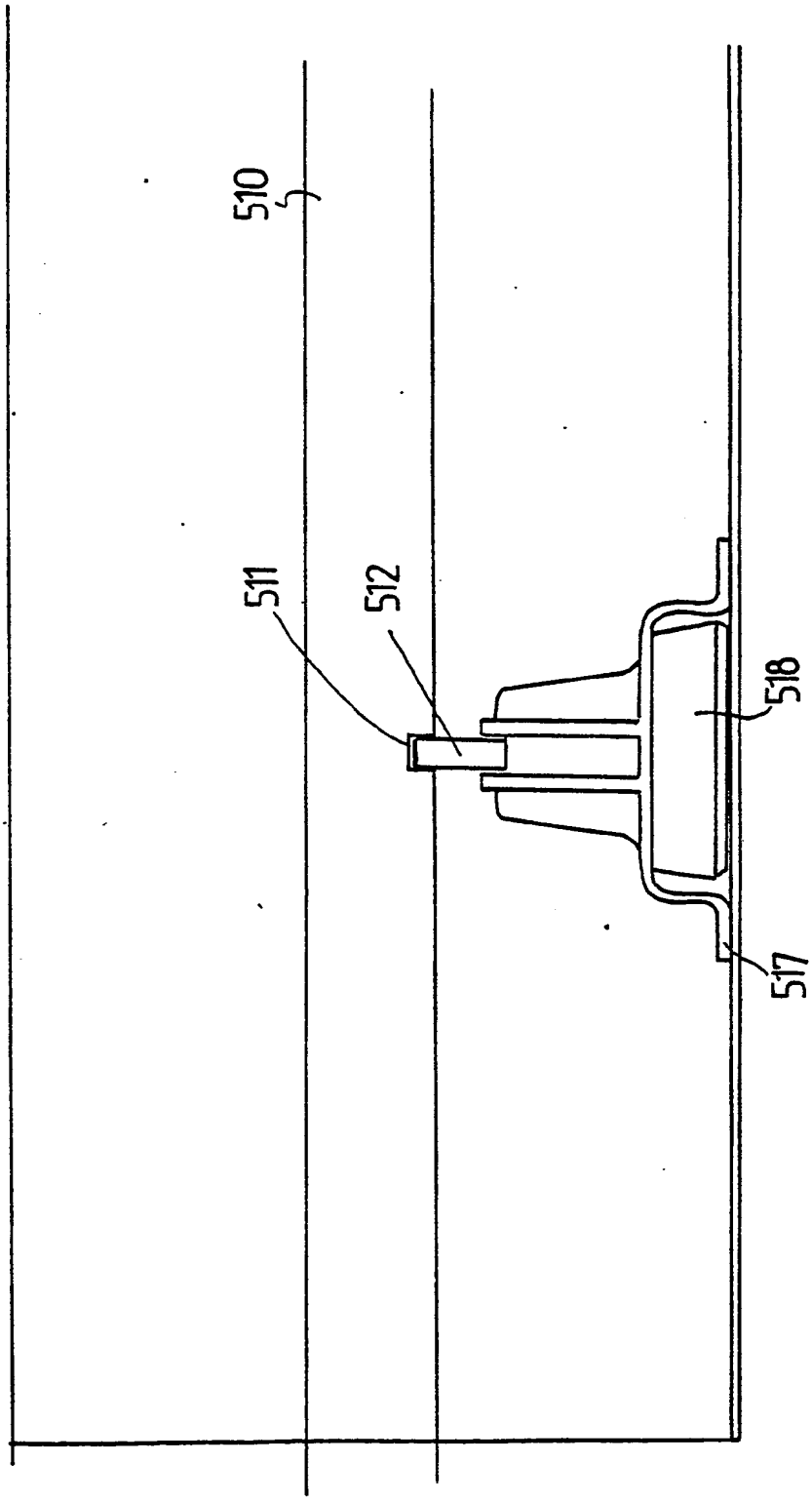


Fig.8

Fig.9



INTERNATIONAL SEARCH REPORT

International Application No PCT/AU 85/00236

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl.[4] B60R 25/02

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC	B60R 25/02

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

AU : IPC as above; Australian Classification 94.9

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	DE,A, 2062388 (AWTOMOBILNY SAWOD IMENI LENNINSKOWO KOMSOMOLA) 6 July 1972 (06.07.72)	(1-2)
X	DE,A, 2637655 (WOERNER) 23 February 1978 (23.02.78)	(3)
X	US,A, 1400507 (ADDIS) 20 December 1921 (20.12.21)	(3)
X,Y	US,A, 3566634 (BORCK) 2 March 1971 (02.03.71)	(2-4)
X,Y	US,A, 1333581 (DE MARTINO) 9 March 1920 (09.03.20)	(2-4)
X	US,A, 4413491 (THIRION) 8 November 1983 (08.11.83)	(2,4)
X,Y	FR,A, 2523532 (PARRIER et al) 23 September 1983 (23.09.83)	(2-4)
X,Y	WO,A, 83/02592 (NEIMAN S.A.) 4 August 1983 (04.08.83)	(2,4)
X,Y	AU,B, 45019/79 (517092) (MOCHIDA et al) 20 March 1980 (20.03.80)	(1-4)
X,Y	AU,B, 27069/71 (453266) (KABUSHIKI-KAISHA TOKAI RIKA DENKI SEISAKUSHO) 5 October 1972 (05.10.72)	(1-4)
X	DE,A, 2427258 (YMOS METALLWERKE WOLF and BECKER GmbH et al) 18 December 1975 (18.12.75)	(2,4)

* Special categories of cited documents: [10]

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
4 December 1985 (04.12.85)	09 DECEMBER 1985 (09. 12. 85)
International Searching Authority	**Signature of Authorized Officer**
Australian Patent Office	P. WARD

ISA/AU

Form PCT/ISA/210 (second sheet) (January 1985)

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON
INTERNATIONAL APPLICATION NO. PCT/AU 85/00236

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report	Patent Family Members		
US 4413491	DE 3121916 JP 57118951	FR 2483867	GB 2078182
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AU 27069/71	JP 7032762 US 3680335	DE 2115133	FR 2092498

END OF ANNEX